REMARKS

Allowable Subject Matter

The Applicants acknowledge with appreciation the statements on Page 14 of the Office Action dated August 10, 2005 that claims 13-16, 22-24, 26-27, 32, 36-38 and 40-43 are allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Rejection Under 35 U.S.C. §112

Claim 12 was rejected under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which the Applicants regards as the invention. The Applicant has amended claim 12 to recite that the optical fiber link further comprises a single-mode optical fiber that couples two segments of the multi-mode optical fiber. The Applicants submit that the amendment to claim 12 overcomes the rejection under 35 U.S.C. §112, second paragraph, and requests that the rejection be withdrawn.

Rejections under 35 U.S.C. §102(b) As Being Anticipated by Shoval

Claims 1, 10, 11, 17-18, 28-29, 39 are rejected under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 6,360,045 to Shoval (hereinafter "Shoval"). To anticipate a claim under 35 U.S.C. §102, a single reference must teach every aspect of the claimed invention either explicitly or impliedly. Any feature not directly taught by the reference must be inherently present in the reference. Thus, a claim is anticipated by a reference only if each and every element of the claim is described, either expressly or inherently, in a single prior art reference.

Independent Claim 1 and Dependent Claims 10-11, and 17-18

The Applicants respectfully submit that Shoval does not describe each and every element of independent claim 1 as currently amended. Independent claim 1, as currently amended, recites a multi-mode optical fiber link that includes a first spatial mode converter that converts the optical signal to a plurality of modes. The amendment is supported in at least FIG. 3B of the

present application, which shows a single mode being converted by the first spatial mode converter to a plurality of modes that include the fundamental mode.

The Applicants believe that the high order spatial mode transmission system described in Shoval is fundamentally different from the multi-mode optical fiber link claimed in amended claim 1. One difference is that the high order spatial mode transmission system described in Shoval is designed to transmit a single higher order spatial mode, while the multi-mode optical fiber link of the present invention is designed to transmit multiple modes including the fundamental mode.

More specifically, the Applicants believe that the spatial mode transformers described in Shoval are fundamentally different from the spatial mode converter recited in amended claim 1. Shoval states in Column 9, lines 31-34 that the transformer 126 may be of the type described in U.S. Patent Application Serial Number 09/248,969, filed on February 12, 1999, which is now U.S. Patent Number 6,404,951 B1, issued June 11, 2002 to Daniziger (hereinafter "Daniziger"). Daniziger describes a traverse spatial mode transformer for dispersion compensation that changes the lower order spatial modes of an optical signal to a higher order spatial mode that is appropriate for dispersion compensation with a special chromatic dispersion compensating fiber that is designed to compensate for dispersion of the signal. See, for example, Daniziger column 5, lines 1-19.

The spatial mode transformer 126 described in Shoval is designed to filter noise by converting the noise into modes that do not easily couple to the single mode optical fiber 112. As described in Shoval Column 9, line 28 to Column 10, line 4, the Shoval high order spatial mode transmission system includes a spatial mode transformer 126 that "converts substantially all of the light to a single higher order spatial mode," such as the LP_{02} spatial mode. See Shoval Column 9 lines 33-35.

The transmission high order mode fiber (THOM) 128 is specifically designed to have a large effective area that is optimized to propagate the desired single higher order spatial mode, such as the LP_{02} spatial mode. A noise component that exists in the LP_{01} spatial mode also passes through the spatial mode transformer 126 and into the THOM 128. Additional noise is

typically generated in the LP_{01} spatial mode while the single higher order spatial mode propagates in the THOM 128.

The second spatial mode transformer 130 converts substantially all signals from the single higher order mode, such as the LP_{02} spatial mode, back to the fundamental LP_{01} spatial mode for transmission in the single mode optical fiber 112. The second spatial mode transformer 130 also transforms any noise in the LP_{01} spatial mode to a higher order spatial mode. The single mode optical fiber attached to the second spatial mode transformer 130 is specifically designed to support only the LP_{01} spatial mode and to prevent the transformed noise in the LP_{01} from propagating. Thus, the spatial mode transformers 126, 130 and the THOM 128 are designed to substantially attenuate noise.

Thus, the first spatial mode converter claimed in amended claim 1 is fundamentally different from the spatial mode transforms 126 described in Shoval. The first spatial mode converter claimed in amended claim 1 converts the optical signal to a plurality of modes including the fundamental mode, and conditions a modal profile of the optical signal for propagation through a multi-mode optical fiber. In contrast, the spatial mode transformer 126 described in Shoval converts a fundamental or low order mode to a single higher order spatial mode. The spatial mode transformer 126 described in Shoval is not designed to transmit multiple modes including the fundamental mode as recited in amended claim 1. In fact, the first spatial mode transformer 126 described in Shoval is specifically designed to block or filter the fundamental mode and multiple higher order modes from passing through.

Therefore, the Applicants submit that amended claim 1 is not anticipated by Shoval for at least the reason that Shoval does not describe the claimed first spatial mode converter that converts the optical signal to a plurality of mode. Thus, the Applicants submit that independent claim 1 as currently amended is allowable over the prior art of record. The Applicants also submit that dependent claims 10-11, and 17-18 are allowable because they depend from an allowable base claim.

Independent Claim 28 and Dependent Claims 29 and 39

The Applicants respectfully submit that Shoval does not describe each and every element of independent claim 28 as currently amended. Independent claim 28, as currently amended, recites a multi-mode optical communication system that includes a first spatial mode converter that converts the optical signal to a plurality of modes and that conditions a modal profile of the optical signal for propagation through a multi-mode optical fiber. As described in connection with the rejection of claim 1, Shoval does not teach the claimed first spatial mode converter for at least the reason that that claim 1 recites a spatial mode converter that converts the optical signal to a plurality of mode including the fundamental mode. As described herein, the first spatial mode transformer 126 described in Shoval is designed to block or filter the fundamental mode and multiple higher order modes from propagating into the THOM 128.

Thus, the Applicants submit that independent claim 28 as currently amended is allowable over the prior art of record. The Applicants also submit that dependent claims 29 and 39 are allowable because they depend from an allowable base claim.

Rejections under 35 U.S.C. §103(a)

Claims 2 and 33 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Shoval and U.S. Patent Number 6,415,076 to DeCusatis. Claims 3-9, 20-21, 34-35 and 44 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Shoval in view of U.S. Patent Number 6,609,834 to Cunningham. Claim 19 has been rejected under 35 U.S.C. §103(a) as being unpatentable over Shoval in view of Danziger. Claim 25 has been rejected under 35 U.S.C. §103(a) as being unpatentable over Shoval in view of Cunningham and U.S Pre Grant Publication Number 2003/0118263 to Phua. Claims 30-31 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Shoval in view of U.S Pre Grant Publication Number 2002/0097941 to Phua.

Independent claims 1 and 28 were amended to recite a first spatial mode converter that converts the optical signal to a plurality of modes. Independent claim 44 was amended to recite a means for spatial mode converting an optical signal to a plurality of modes. As

described herein, these limitations in combination with the other elements of these claims are not taught or suggested by the prior art of record. The Applicants submit that independent claims 1, 28, and 44 are allowable over the prior art of record. Therefore, the Applicants submit that dependent claims 2-9, 19, 30-31, and 33-35 are allowable as depending upon an allowable base claim.

In addition, independent claim 20 was amended to recite the step of spatial mode converting an optical signal to a plurality of modes. As described herein, this limitation in combination with the other elements of this claims is not taught or suggested by the prior art of record. The Applicants submit that independent claim 20 is allowable over the prior art of record as described herein. Therefore, the Applicants submit that dependent claims 20-21 and 25 are allowable as depending upon an allowable base claim.

CONCLUSION

Claims 1-44 are pending in the present application. Claims 1, 12, 28, and 44 have been amended. The Applicant respectfully requests reconsideration of the pending claims in light of the amendments and arguments presented in this Amendment and Response.

If, in the Examiner's opinion, a telephonic interview would expedite prosecution of the present application, the undersigned attorney would welcome the opportunity to discuss any outstanding issues, and to work with the Examiner toward placing the application in condition for allowance.

Respectfully submitted,

Date: December 9, 2005
Reg. No. 40,137

Kurt Rauschenbach, Ph.D.
Attorney for Applicant
Rauschenbach Patent Law Group, LLC
Post Office Box 387
Bedford, MA 01730

Tel. No.: (781) 271-1503
Fax No.: (781) 271-1527

1754v1